

# INTRODUCING STORMS



## **Thunderstorm =**

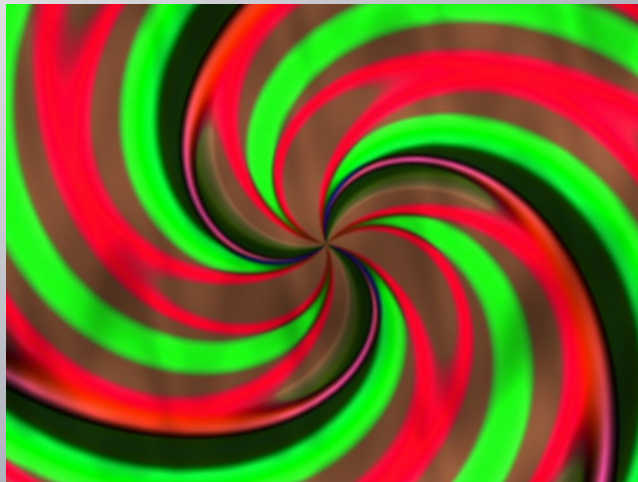
- A disturbance in the earth's atmosphere that involves lightning, thunder, and sometimes gusty surface winds with heavy rain and hail
- May form in a single, cluster, or line of **cumulonimbus clouds**
  - Exceptionally dense, tall clouds often shaped like an anvil at the top





## **Vortex =**

- Movement of liquids or gases in a spiral around a central axis
- In a storm, it is the calm center area around which clouds spiral
- Results from rapid downdraft of cold air replacing rising, hot air





### **Tornado =**

- A violent windstorm that spirals around a rotating column of air (vortex) of intense low pressure
- Moves in a narrow path over land

### **Tornado watch =**

- Communication to the public that tornadoes are possible

### **Tornado warning =**

- Communication to the public that a tornado has been seen by someone or detected by radar



## **Hurricane =**

- Massive, rotating storm that forms north of the equator in the Atlantic Ocean, eastern Pacific Ocean, or Caribbean Sea when warm air rises over tropical waters
- Has sustained winds of more than 119 km per hour
- Has an interior region of intense low pressure



- Center of the hurricane is known as the **eye**
  - Rising temperatures and low pressure
  - Bright sky, no rainfall, low winds
- Adjacent to the eye of the hurricane is the **eye wall**
  - Ring of spiraling clouds and thunderstorms that whirl around the storm's center
  - Heavy precipitation and strong winds





- Can affect a much larger region than a tornado
- “Hurricane season” is from June through November



Other names for hurricanes in different regions of the world:

**Typhoon** =

- Massive rotating storm that forms north of the equator in the western Pacific Ocean

**Cyclone** =

- Massive rotating storm that forms in the Indian Ocean and off the coast of Australia



# HEATING EARTH



The transfer of heat energy is a major factor in the formation of weather

- **Weather** =
  - State of the atmosphere at a particular time and place
  - Day-to-day variations in temperature, air pressure, wind, humidity, and precipitation
- **Climate** =
  - Average temperature and precipitation conditions of a region over time



Heat can be transferred by:

- **Radiation** =

- Transfer of heat energy from one object to another without the space between them being heated
- Example: Energy from the sun heating Earth



- **Conduction** =

- Transfer of heat energy from one material to another through direct contact
- Example: A metal pan used to heat food

- **Convection** =

- Transfer of heat energy through a fluid, such as air or water
- Example: Air above a warm surface heats up



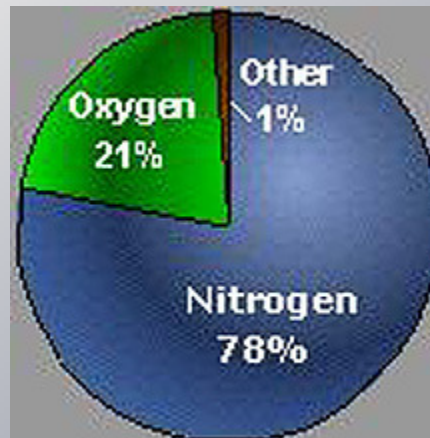
# THE ATMOSPHERE



- The earth is surrounded by a blanket of air called the **atmosphere**
  - It reaches over 560 kilometers (348 miles) from the surface of Earth
  - Absorbs energy from the sun
  - Recycles water and other chemicals
  - Works with electrical and magnetic forces to provide a moderate climate
  - Protects us from high-energy radiation



- Composition of the atmosphere
  - 78% Nitrogen
  - 21% Oxygen
  - 1% other trace gases
    - Including water vapor, carbon dioxide, and other “greenhouse gases”



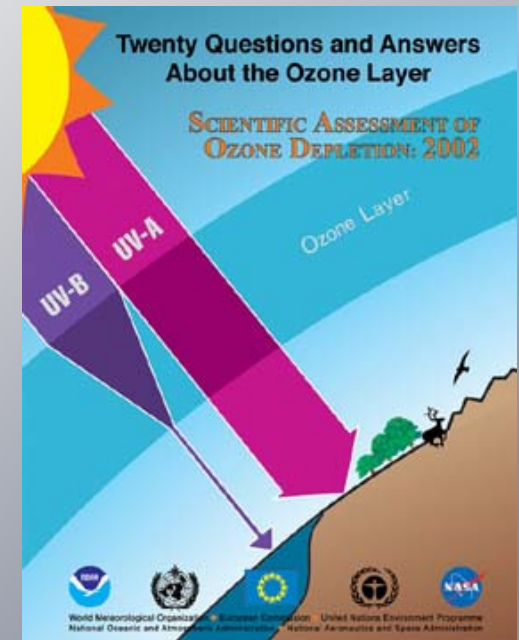


- Layers of the atmosphere
  - **Troposphere** =
    - Starts at Earth's surface and extends about 15km
    - Most dense
    - Temperature drops as you climb higher in the layer
    - Almost all weather is in this region
    - **Tropopause** =
      - Separates troposphere from next layer



– **Stratosphere** =

- Starts just above troposphere and extends about 50km above Earth's surface
- Dry and less dense
- Temperature increases gradually as you climb higher in the layer
- Contains **ozone layer** =
  - Absorbs and scatters solar ultraviolet radiation
- **Stratopause** =
  - Separates stratosphere from next layer





– **Mesosphere** =

- Starts just above stratosphere and extends to about 80km
- Temperatures drop as you climb higher in the layer
- Meteoroids burn up here

• **Mesopause** =

- Separates mesosphere from thermosphere



– **Thermosphere** =

- Starts just above mesosphere and extends to about 500km
- Temperatures increase as you climb higher in the layer due to the Sun's energy
- Northern lights occur here

• **Ionosphere** =

- Exists in lower thermosphere between 80km and 280km





– **Exosphere** =

- Starts at top of thermosphere and continues until it merges with space (about 1000km)
- Mostly hydrogen and helium
- Most satellites orbit here



# TEMPERATURE AND PRESSURE



- **Atmospheric pressure** =
  - The force that air exerts on everything on Earth
    - ie-the weight of air
  - Also known as **air pressure**
  - The amount of pressure that air exerts on water and land depends on
    - The degree to which air is energized by the sun's heat



- Pressure at any point in the atmosphere can be measured in terms of the total weight of the air above that point
  - Increasing altitude
    - Atmospheric pressure decreases
  - Decreasing altitude
    - Atmospheric pressure increases



– **Bar** =

- Unit of pressure that describes a force over a given area

– **Barometer** =

- Instrument used to detect and measure changes in air pressure

– Because scientists measure atmospheric pressure with a barometer, atmospheric pressure is often referred to as **barometric pressure**





- **Dew point** =
  - The temperature at which water vapor begins to condense at a constant barometric pressure
- **Humidity** =
  - The amount of water vapor in the air
  - Note:
    - Warm air can hold more moisture than cold air
- **Relative humidity** =
  - The amount of water vapor in the air compared to the total amount air could hold at that temperature (%)
  - When relative humidity is high
    - The dew point is closer to the current air temperature



# THE WATER CYCLE AND CLOUD FORMATION



# The Water Cycle

## 1. **Evaporation**

- Water absorbs heat energy and changes from a liquid to a gas (water vapor)

## 2. Warm air rises. . .because it is less dense

- It carries the water vapor with it

## 3. The air cools at higher altitudes in the troposphere

- Cold air can't hold as much moisture



#### **4. Condensation**

- Water vapor changes from a gas to a liquid

#### **5. Cloud formation \***

- Water vapor condenses on dust particles

#### **6. Precipitation forms**

- It takes close to a billion cloud droplets to provide enough water for each raindrop



7. Precipitation lands and can then do any of the following:

- Infiltrate into the groundwater
- Runoff the surface
- Evaporate and start the cycle over again



# What Conditions lead to Cloud Formation?

- Temperature
  - When dew point and temperature are close to each other, condensation results
  - If that water condenses on dust, a cloud is formed
- Pressure
  - High pressure usually brings clear skies
  - Low pressure usually leads to clouds and precipitation



# WEATHER FRONTS



- **Weather fronts** =

- Boundaries that form when air masses meet that have different temperature, pressure, and humidity conditions
- Bring changes in the weather
- Types
  - Cold front
  - Warm front
  - Stationary front
  - Occluded front



- **Cold front**

- Cold air mass pushes a warm air mass ahead of it
- Moves fast
  - Causes abrupt changes in weather like thunderstorms and tornadoes



- **Warm front**

- Moving, warm air mass overrides a cold air mass ahead of it
- Moves more slowly
  - Rainy weather usually stays around for days



- **Stationary front**

- Two air masses move close to one another, but neither has enough force to move the other
- Rain, snow, fog, or clouds result

- **Occluded front**

- Both a cold and cool air mass collide with a warm air mass, which becomes trapped and lifted between them